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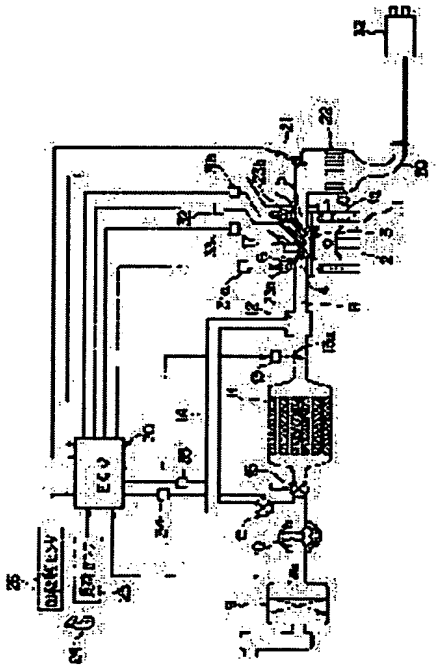
(54) COMBUSTION CONTROLLER OF COMPRESSION IGNITION ENGINE

(57)Abstract:
PROBLEM TO BE SOLVED: To expand a compression ignition range by suppressing the occurrence of abnormal combustion in the high-load operating region and preventing ignition in the high rotation region from being delayed.
SOLUTION: An intercooler 11 and an I/C bypass passage 14, bypassing the intercooler 11, are made to communicate with the downstream side of a mechanical supercharger 10, and at control of compression ignition combustion, a main passage opening/closing valve 16 is closed and a bypass passage opening/ closing valve 15 are made to open, until knocking is detected to supply the supercharged intake to a combustion chamber 3 via a bypass passage 14, to prevent ignition in the high rotation range from delay. When knocking is detected, the main passage opening/closing valve 16 is opened, and the bypass passage opening/closing valve 15 are closed, to cool the supercharged intake in the intercooler 11, and then air supply to the combustion chamber 3 is made, so as to suppress the occurrence of abnormal combustion in the high-load operating range.



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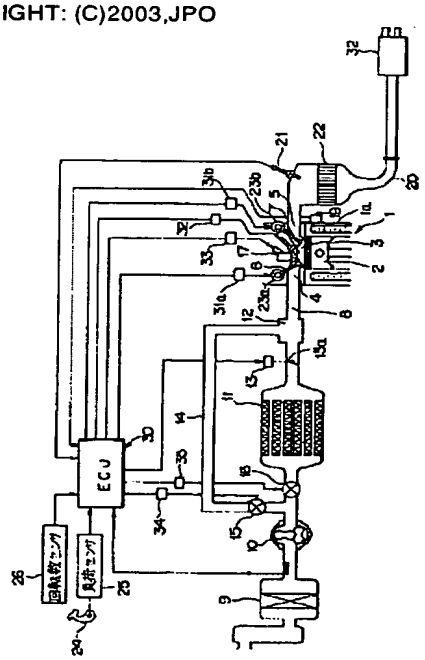

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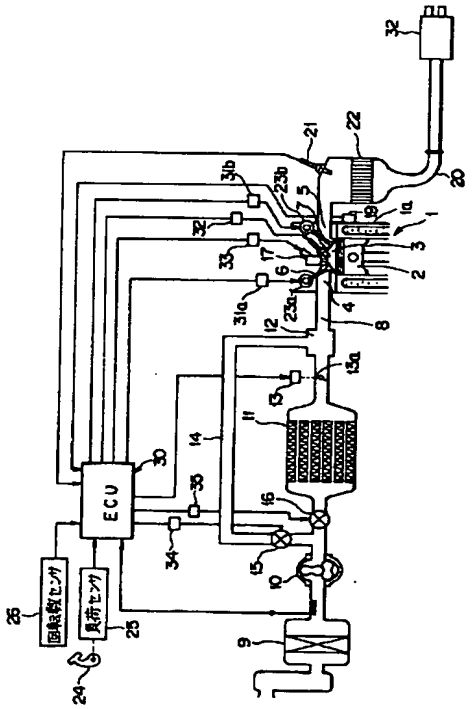
(54)【発明の名称】　圧縮着火式エンジンの燃焼制御装置

(57)【要約】
【課題】高負荷運転領域での異常燃焼の発生を抑制すると共に高回転領域での着火の遅延を防止して圧縮着火領域の拡大を図る。
【解決手段】機械式過給機１０の下流にインタクーラ１１と、インタクーラ１１を迂回するＩ/Ｃバイパス通路１４とを連通し、圧縮着火燃焼制御時は、ノッキングが検出されるまで、メイン通路開閉弁１６を閉弁すると共にバイパス通路開閉弁１５を開弁させて、過給された吸気をバイパス通路１４を経て燃焼室３へ供給し、高回転領域での着火の遅延を防止する。又ノッキングが検出されたときは、メイン通路開閉弁１６を開弁すると共にバイパス通路開閉弁１５を閉弁させて、過給された吸気をインタクーラ１１にて冷却した後、燃焼室３へ供給し、高負荷運転領域での異常燃焼の発生を抑制する。



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【特許請求の範囲】

【請求項１】吸気メイン通路に配設した過給機により過給された吸気と、インジェクタから噴射される燃料とを燃焼室に供給し、生成された混合ガスを圧縮着火燃焼させる圧縮着火式エンジンの燃焼制御装置において、

上記吸気メイン通路の上記過給機の下流に配設した吸気冷却器と、

一端を上記過給機と上記吸気冷却器との間の上記吸気メイン通路に連通し、他端を上記吸気冷却器の下流側の上記吸気メイン通路に連通するバイパス通路と、

上記過給機に対して上記バイパス通路と上記吸気冷却器とを選択的に接続する通路切換え手段と、

上記燃焼室内の異常燃焼を検出する異常燃焼検出手段と、

上記異常燃焼検出手段で異常燃焼が検出されたとき上記通路切換え手段を動作させて上記過給機と上記吸気冷却器側とを連通し、又上記異常燃焼検出手段で異常燃焼が検出されないときは上記通路切換え手段を動作させて上記過給機と上記バイパス通路とを連通させる通路切換え制御手段とを備えることを特徴とする圧縮着火式エンジンの燃焼制御装置。

【請求項２】吸気弁と排気弁とのバルブタイミングを可変設定可能な可変動弁機構と、

燃焼形態が圧縮着火燃焼のときは上記可変動弁機構によるバルブタイミングを排気上死点前後にかけて上記排気弁と上記吸気弁とを共に閉弁する負のバルブオーバラップ期間を形成するように設定するバルブタイミング設定手段とを備えることを特徴とする請求項１記載の圧縮着火式エンジンの燃焼制御装置。

【請求項３】上記インジェクタは上記燃焼室内に燃料を直接噴射する筒内噴射用インジェクタであることを特徴とする請求項１或いは２記載の圧縮着火式エンジンの燃焼制御装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、異常燃焼が発生したときは燃焼室内のガス温度を低下させるようにした圧縮着火式エンジンの燃焼制御装置に関する。

【０００２】

【従来の技術】４サイクルエンジンの熱効率を向上させる手段として、混合ガスをリーン化させることで作動ガスの比熱比を大きくして理論熱効率を向上させることが知られている。又、混合ガスをリーン化することにより、同じトルクで運転する場合でも、より多くの空気をエンジンに吸入させるので、ポンピング損失を低減させることができる。

【０００３】しかし、混合ガスのリーン化は燃焼期間の長期化や燃焼の不安定化を伴い限界がある。そこで、筒内噴射によって、混合ガスを成層化した状態のまま点火プラグの周囲に集め着火性を確保する成層燃焼により、

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この限界を拡げるようにしているが、成層燃焼では、点火プラグ周りにリッチ混合ガスを集中させるので、燃焼温度が高くなり、ＮＯｘが増大し易いという問題がある。

【０００４】一方、ディーゼルエンジンは、圧縮着火により燃焼させるため熱効率が高く、空燃比の大幅なリーン化は可能であるが、高負荷時の空気利用率が悪いため、出力が低く、煤の排出を生じることがあり、排気ガス対策上問題となる。

【０００５】そこで、このような問題を解決する手段として、ガソリン混合ガスを点火プラグを用いず、断熱圧縮により多点着火させる圧縮着火式エンジンが提案されている。ガソリン混合ガスを圧縮着火燃焼させるためには、高温の残留ガス熱を利用して新気を活性化させる必要があり、その１つの方法として、排気弁の閉弁時期を早め、吸気弁の開弁時期を遅らせることで、排気上死点前後で両弁が閉弁する負のオーバラップ期間を形成し、排気行程後半から吸気行程前半にかけて残留ガスを燃焼室内に閉じ込めるようにした技術が知られている。

【０００６】例えば特開２０００－６４８６３号公報には、排気上死点前後で排気弁と吸気弁との双方を閉じる負のバルブオーバラップ期間を設け、燃焼室に閉じ込めた残留ガスの予圧昇温により、圧縮着火を促進させる技術が開示されている。

【０００７】

【発明が解決しようとする課題】ところで、上述した先行技術では、排気上死点前後にかけての負のバルブオーバラップ期間を制御することで、熱効率の向上を図るようにしているが、残留ガスの熱エネルギは、エンジン負荷に応じて変動する。すなわち、低負荷運転時の残留ガス温度は低く、高負荷運転へ移行するに従い次第に高くなる。更に、負のバルブオーバラップ期間により、吸気弁の開弁時期が遅れるため、高回転領域へ移行するに従い、体積効率が次第に低下し、筒内の混合ガスの着火可能温度に達する時期に遅れが生じてしまう。

【０００８】その結果、高負荷運転領域では混合ガス温度が高くなり過ぎてノッキング等の異常燃焼が発生し易くなり、又高回転領域では、混合ガス温度を十分に上昇させることができずに着火不良を招いてしまう。そのため、必然的に、圧縮着火領域が狭められてしまう不都合がある。

【０００９】本発明は、上記事情に鑑み、高負荷運転領域での異常燃焼の発生を抑制すると共に、高回転領域での着火の遅延を防止して、圧縮着火領域の拡大を図ることのできる圧縮着火式エンジンの燃焼制御装置を提供することを目的とする。

【００１０】

【課題を解決するための手段】上記目的を達成するため本発明は、吸気メイン通路に配設した過給機により過給された吸気と、インジェクタから噴射される燃料とを燃

焼室に供給し、生成された混合ガスを圧縮着火燃焼させる圧縮着火式エンジンの燃焼制御装置において、上記吸気メイン通路の上記過給機の下流に配設した吸気冷却器と、一端を上記過給機と上記吸気冷却器との間の上記吸気メイン通路に連通し、他端を上記吸気冷却器の下流側の上記吸気メイン通路に連通するバイパス通路と、上記過給機に対して上記バイパス通路と上記吸気冷却器とを選択的に接続する通路切換え手段と、上記燃焼室内の異常燃焼を検出する異常燃焼検出手段と、上記異常燃焼検出手段で異常燃焼が検出されたとき上記通路切換え手段を動作させて上記過給機と上記吸気冷却器側とを連通し、又上記異常燃焼検出手段で異常燃焼が検出されないときは上記通路切換え手段を動作させて上記過給機と上記バイパス通路とを連通させる通路切換え制御手段とを備えることを特徴とする。

【００１１】このような構成では、燃焼室内の異常燃焼を検出する異常燃焼検出手段にて異常燃焼が検出されない場合、通路切換え制御手段は通路切換え手段を動作させて過給機とバイパス通路とを連通させる。すると、過給機にて過給された吸気が、吸気冷却器を迂回するバイパス通路を経て燃焼室へ供給される。燃焼室に供給される吸気が過給機により過給昇温されているため、筒内混合ガスの昇温が促進され、且つ高回転側の体積効率の低下が抑制され、圧縮着火時期における着火遅延を防止することが出来る。一方、異常燃焼検出手段にて異常燃焼が検出された場合、通路切換え制御手段は通路切換え手段を動作させて過給機と吸気冷却器とを連通させる。すると、過給機にて過給された吸気が、吸気冷却器にて冷却された後、燃焼室へ供給される。燃焼室に供給される吸気が冷却されるため、異常燃焼を回避することができる。

【００１２】この場合、好ましくは、１）吸気弁と排気弁とのバルブタイミングを可変設定可能な可変動弁機構と、燃焼形態が圧縮着火燃焼のときは上記可変動弁機構によるバルブタイミングを排気上死点前後にかけて上記排気弁と上記吸気弁とを共に閉弁する負のバルブオーバラップ期間を形成するように設定するバルブタイミング設定手段とを備えることを特徴とする。

【００１３】２）上記インジェクタは上記燃焼室内に燃料を直接噴射する筒内噴射用インジェクタであることを特徴とする。

【００１４】

【発明の実施の形態】以下、図面に基づいて本発明の一実施の形態を説明する。図１にエンジンの全体構成図を示す。

【００１５】同図の符号１はエンジン本体、２はピストン、３は燃焼室、４は吸気ポート、５は排気ポート、６は吸気弁、７は排気弁であり、吸気ポート４に吸気メイン通路８が連通され、この吸気メイン通路８の上流端にエアクリーナ９が配設されている。又、吸気メイン通路

８のエアクリーナ９の下流に、エンジンによって駆動される機械式過給機１０が配置され、この機械式過給機１０の下流に、吸気冷却器としてのインタクーラ１１が介装されており、このインタクーラ１１の更に下流にエアチャンバ１２が形成されている。又、吸気メイン通路８のインタクーラ１１とエアチャンバ１２との間にスロットル弁１３ａが配設されている。このスロットル弁１３ａはスロットル開度を電子的に制御する電子制御スロットル装置１３に連設されている。

【００１６】又、吸気メイン通路８の機械式過給機１０とインタクーラ１１との間に、Ｉ／Ｃバイパス通路１４の上流端が連通され、一方Ｉ／Ｃバイパス通路１４の下流端がエアチャンバ１２に連通されている。尚、Ｉ／Ｃバイパス通路１４の下流端は、吸気メイン通路８のインタクーラ１１とスロットル弁１３ａとの間に開口されていても良い。

【００１７】更に、Ｉ／Ｃバイパス通路１４の上流側にバイパス通路開閉弁１５が介装され、又、吸気メイン通路８のインタクーラ１１の上流とＩ／Ｃバイパス通路１４の上流端との間にメイン通路開閉弁１６が介装されている。尚、この両開閉弁１５，１６で通路切換え手段が構成されている。

【００１８】更に、燃焼室３の頂面に筒内噴射用インジェクタ１７の噴孔と、点火プラグ１８の発火部とが臨まされている。又、シリンダブロック１ａに、異常燃焼であるノッキング発生の有無を検出する、異常燃焼検出手段の一例であるノックセンサ１９が配設されている。

又、排気ポート５に連通する排気通路２０に、O2センサ或いは広域空燃比センサ等の空燃比センサ２１が臨まされ、この空燃比センサ２１の下流に、排気ガス中のＣＯ，ＨＣの酸化とＮＯｘの還元を行って浄化する三元触媒２２が介装されている。

【００１９】尚、本実施の形態で採用するエンジンは、ノッキング等の異常燃焼を抑制しつつ、通常の火花点火による高負荷運転が実現できるように、圧縮比が実用領域で運転可能な低い値（例えば１２～１４程度）に設定されている。

【００２０】又、吸気弁６と排気弁７とが、可変動弁機構２３ａ，２３ｂに各々連設されている。この各可変動弁機構２３ａ，２３ｂは、プロフィールの異なる２種類のカム山を切り換える２段式カム機構や、周知の電磁動弁等を用いた連続可変動弁機構等で構成されており、後述する電子制御ユニット（ＥＣＵ）３０からの制御信号に基づき、運転領域に応じて切換え動作される。

【００２１】ところで、ＥＣＵ３０では、エンジン負荷Ｌｏとエンジン回転数Ｎｅとに基づき、図５に示す運転領域判定マップを参照して、運転領域を判定する。運転領域は、低中負荷で且つ低中回転領域の圧縮着火領域（Ｉ）と、高負荷領域或いは高回転領域の火花点火領域（II）とに区分されており、圧縮着火領域（Ｉ）では、

空燃比の超リーンな圧縮着火燃焼を行い、火花点火領域（II）では、通常の火花点火燃焼を行なう。圧縮着火燃焼は、ＮＯｘ生成温度以下で燃焼させることができるため、ＮＯｘがほとんど発生せず、しかも、空気過剰率が高いので、三元触媒２９は排気ガス中のＣＯとＨＣとを酸化反応により浄化する、酸化触媒として機能させる。

【００２２】そして、運転領域が圧縮着火領域（Ｉ）にあり、燃焼形態が圧縮着火燃焼に設定されたときは、図４（ａ）に示すように、バルブタイミングが、排気上死点（ＴＤＣ）前後で、排気弁７と吸気弁６とが共に閉弁する負のバルブオーバラップ期間が形成されるように切換えられる。又、運転領域が火花点火領域（II）にあり、燃焼形態が通常の火花点火燃焼に設定されたときは、同図（ｂ）に示すように、バルブタイミングが、排気上死点（ＴＤＣ）前後で、排気弁７と吸気弁６とが共に開弁する、正のバルブオーバラップ期間が形成されるように切換えられる。

【００２３】上述した各センサで検出した情報は電子制御ユニット（ＥＣＵ）３０に入力される。このＥＣＵ３０は、マイクロコンピュータを中心として構成されており、このＥＣＵ３０の入力側には、上述した各センサ以外に、アクセルペダル２４の踏込み量からエンジン負荷Ｌｏを検出する負荷センサ２５、エンジン回転数Ｎｅを検出する回転数センサ２６等、エンジンの運転状態を検出する各種センサ・スイッチ類が接続されている。

【００２４】又、ＥＣＵ３０の出力側に、吸気弁駆動回路３１ａ、排気弁駆動回路３１ｂを介して各可変動弁機構２３ａ，２３ｂが個別に接続され、点火駆動回路３２を介して点火プラグ１８が接続され、インジェクタ駆動回路３３を介して筒内噴射用インジェクタ１７が接続されている。更に、ＥＣＵ３０の出力側には、電子制御スロットル装置１３が接続されていると共に、バイパス通路開閉弁１５、メイン通路開閉弁１６が駆動回路３４，３５を介して各々接続されている。

【００２５】尚、図示しないが、吸気メイン通路８には、機械式過給機１０をバイパスするバイパス通路が設けられており、このバイパス通路に過給圧を制御する過給圧制御弁が介装されている。この過給圧制御弁は、例えば高回転且つ高負荷運転時に開弁されて、高回転且つ高負荷運転時の過給圧を低下させて、火花点火領域（II）でのノッキング等の異常燃焼を回避する。

【００２６】ＥＣＵ３０は、回転数センサ２６で検出したエンジン回転数Ｎｅと、負荷センサ３３で検出したエンジン負荷Ｌｏとに基づき運転領域が、圧縮着火領域（Ｉ）にあるか、火花点火領域（II）にあるかを調べる。そして、圧縮着火領域（Ｉ）にあると判断したときは、スロットル弁１３ａを全開動作させると共に、排気弁７と吸気弁６とのバルブタイミングを、排気上死点（ＴＤＣ）前後で、排気弁７と吸気弁６とが共に閉弁する負のバルブオーバラップ期間が形成されるように制御する。

【００２７】すると、負のバルブオーバラップ期間中に燃焼室３内に残留ガスが閉じ込められ、この残留ガスと機械式過給機１０により加圧された状態で燃焼室３へ供給される吸気とを、圧縮行程時の断熱圧縮により予圧昇温させて、圧縮着火燃焼を行なわせる。その結果、圧縮比を実用領域で運転可能なように低く設定しても筒内ガスを圧縮着火可能な温度まで昇温させることが可能となる。

【００２８】又、運転領域が火花点火領域（II）にあると判断したときは、スロットル弁１３ａをアクセルペダル２４に連動させた動作とすると共に、排気弁７と吸気弁６とのバルブタイミングを、排気上死点（ＴＤＣ）前後で、排気弁７と吸気弁６とが共に開弁する正のバルブオーバラップ期間が形成されるように切換える。更に、機械式過給機１０をバイパスするバイパス通路に介装されている過給圧制御弁（図示せず）を制御し、過給圧を調整することで、ノッキング等の異常燃焼を回避しつつ、通常の火花点火燃焼制御を行なう。

【００２９】運転領域が、圧縮着火領域（Ｉ）にあるとき、バイパス通路開閉弁１５が開弁され、メイン通路開閉弁１６が閉弁される。従って、機械式過給機１０により加圧された吸気は、Ｉ／Ｃバイパス通路１４を通り、エアチャンバ１２を経て燃焼室３へ供給される。そして、ノックセンサ１９の出力信号をモニタし、ノッキング等の異常燃焼が検出されたときは、直ちにバイパス通路開閉弁１５を閉弁すると共に、メイン通路開閉弁１６を開弁する。すると、機械式過給機１０がインタクーラ１１に接続され、機械式過給機１０により過給昇温された吸気は、インタクーラ１１により冷却されて燃焼室３へ供給されるため、ノッキングなどの異常燃焼が回避される。

【００３０】一方、運転領域が火花点火領域（II）にあるときは、バイパス通路開閉弁１５が閉弁され、メイン通路開閉弁１６が開弁されて、過給された吸気はインタクーラ１１により冷却されて燃焼室３へ供給されるため、充填効率が高くなる。

【００３１】ところで、上述したように圧縮着火領域（Ｉ）では、負のバルブオーバラップ期間を形成するために吸気弁６の開弁時期が、通常の火花点火制御時に比し遅角される。そのため、高回転側へ移行するに従い体積効率が低下し易くなるが、過給された吸気が供給されるため体積効率の低下が抑制され、しかも、機械式過給機１０を通過する際に吸気温度が上昇されているので、圧縮行程時の断熱圧縮による混合ガスの昇温が促進され、良好な圧縮着火燃焼を得ることができる。又、過給した吸気が燃焼室３に供給されるため、圧縮比を低く設定しても、筒内圧力を高めることが可能となる。

【００３２】この場合、高負荷運転時や吸気温度が高すぎて、ノッキング等の異常燃焼が発生した場合は、過給

された空気をインタクーラ１１により冷却した後、燃焼室３へ供給するようにしてノッキングの発生を抑制するようにしたので、図５にハッチングで示すように、圧縮着火領域（Ｉ）を、高負荷側、及び高回転側へ限界近くまで拡大させることが可能となる。

【００３３】ＥＣＵ３０は、燃料噴射制御機能、点火時期制御機能等、通常の燃焼制御機能に加え、バルブタイミング設定機能、及び、各通路開閉弁１５，１６の切換え制御を行なう通路切換え制御機能を備えている。燃焼制御機能、及びバルブタイミング設定機能は、具体的には、図２に示す燃焼制御ルーチンに従って実行され、又、通路切換え制御機能は、図３に示す通路切換え制御ルーチンに従って実行される。

【００３４】図２に示す燃焼制御ルーチンでは、先ず、ステップＳ１で、エンジン回転数Ｎｅとエンジン負荷Ｌｏとに基づき、図５に示す運転領域マップを参照して、運転領域を調べる。

【００３５】そして、運転領域が、圧縮着火領域（Ｉ）にあるときはステップＳ２へ進み、スロットル弁１３ａを全開動作させた後、ステップＳ３へ進み、可変動弁機構２３ａ，２３ｂに対し、負のバルブオーバラップ期間（図４（ａ）、図６（ａ）参照）を形成するバルブタイミングとなる駆動信号を出力する。すなわち、可変動弁機構２３ａ，２３ｂが２段式カム機構の場合は、負のバルブオーバラップを形成するカム山を選択する信号を出力し、又、連続可変動弁機構の場合は負のバルブオーバラップを形成するタイミングでバルブ開閉信号を出力する。

【００３６】すると、排気弁７の閉弁時期ＥＶＣが、排気上死点（ＴＤＣ）よりも前側へ進角され、又、吸気弁６の開弁時期ＩＶＯが排気上死点（ＴＤＣ）よりも後側へ遅角され、この両弁６，７が共に閉弁する負のバルブオーバラップ期間において、燃焼室３内に残留ガスが閉じ込められる（図６（ｂ）参照）。そして、ピストン２が排気上死点（ＴＤＣ）を通過して吸気行程へ移行し、開弁時期ＩＶＯにおいて吸気弁６が開弁されると、機械式過給機１０により過給された吸気が燃焼室３へ導かれる。この吸気は燃焼室内に供給されると残留ガスの熱エネルギによって加熱昇温されると共に、圧縮行程時の断熱圧縮によっても昇温される。

【００３７】次いで、ステップＳ４へ進み、圧縮着火燃焼制御を実行してルーチンを抜ける。圧縮着火燃焼制御では、圧縮着火燃焼可能な燃料噴射時期、燃料噴射量を設定し、所定噴射時期に達したとき、筒内噴射用インジェクタ１７から噴射させる（図６（ｂ）参照）。尚、この場合、圧縮着火領域（Ｉ）を成層圧縮着火領域と均一圧縮着火領域とに細分し、各領域毎に燃料噴射時期を可変設定するようにしても良い。

【００３８】又、ステップＳ１で、運転領域が火花点火領域（II）にあると判定されてステップＳ５へ進むと、通常の火花点火による燃焼制御を実行してルーチンを抜ける。火花点火燃焼制御へ移行すると、可変動弁機構２３ａ，２３ｂに対し、正のバルブオーバラップ期間（図４（ｂ）参照）を形成するバルブタイミングとなる駆動信号を出力する。すなわち、可変動弁機構２３ａ，２３ｂが２段式カム機構の場合は、正のバルブオーバラップを形成するカム山を選択する信号を出力し、又、連続可変動弁機構の場合は正のバルブオーバラップを形成するタイミングでバルブ開閉信号を出力する。

【００３９】その結果、吸気弁６及び排気弁７が、通常の火花点火時のバルブタイミング、すなわち排気行程終期から吸気行程初期にかけて共に開弁する正のバルブオーバラップ期間（図４（ｂ）参照）で動作される。

【００４０】同時に、スロットル弁１３ａをアクセルペダル２４に連動させた動作とする。更に、メイン通路開閉弁駆動回路３５を介してメイン通路開閉弁１６を開弁動作させると共に、バイパス通路開閉弁駆動回路３４を介してバイパス通路開閉弁１５を閉動作させる。その結果、機械式過給機１０により過給され、或いはこの機械式過給機１０をバイパスするバイパス通路（図示せず）を通過した吸気が、吸気メイン通路８を通り、インタクーラ１１で冷却された後、燃焼室３へ供給される。

【００４１】更に、燃料噴射量、燃料噴射時期、及び点火時期等を通常の火花点火制御に戻す。尚、火花点火制御時の燃料噴射制御、及び点火時期制御は公知であるため、ここでの説明は省略する。

【００４２】又、運転領域が圧縮着火領域（Ｉ）にあると判定されると、図３に示す通路切換え制御ルーチンが起動される。

【００４３】このルーチンでは、先ず、ステップＳ１１で、ノックセンサ１９の出力信号からノッキング発生の有無を調べ、ノッキングが発生していない場合、ステップＳ１２へ進み、メイン通路開閉弁駆動回路３５に対してメイン通路開閉弁１６を閉弁する信号を出力し、次いで、ステップＳ１３で、バイパス通路開閉弁駆動回路３４に対しバイパス通路開閉弁１５を開弁させる信号を出力し、ルーチンを抜ける。

【００４４】すると、インタクーラ１１に連通する吸気メイン通路８が遮断され、又、Ｉ／Ｃバイパス通路１４が開通され、機械式過給機１０により過給された吸気が、Ｉ／Ｃバイパス通路１４を通り、インタクーラ１１にて冷却されることなく、燃焼室３に供給される。

【００４５】燃焼室３には過給された吸気が供給されるため、高回転側での体積効率の低下が抑制され、しかも、この吸気はインタクーラ１１にて冷却されることなく、昇温された状態で燃焼室３に供給されるため、高回転側であっても燃焼室３内の混合ガスを自着火可能な温度まで十分に昇温させることができ、相対的に、圧縮着火領域（Ｉ）を高回転側へ拡大させることができる。

【００４６】一方、ステップＳ１１で、ノッキングの発

生が検出された場合、ステップＳ４へ分岐し、メイン通路開閉弁駆動回路３５に対してメイン通路開閉弁１６を開弁する信号を出力し、次いで、ステップＳ１５で、バイパス通路開閉弁駆動回路３４に対しバイパス通路開閉弁１５を閉弁させる信号を出力し、ルーチンを抜ける。

【００４７】すると、インタクーラ１１に連通する吸気メイン通路８が開通され、又、Ｉ／Ｃバイパス通路１４が遮断され、機械式過給機１０により過給された吸気が、吸気メイン通路８を通り、インタクーラ１１にて冷却された後、燃焼室３に供給される。

【００４８】ノッキングが発生した場合、燃焼室３に供給される吸気をインタクーラ１１にて冷却するため、残留ガスの熱エネルギが高い高負荷運転時や、機械式過給機１０から吐出される吸気の温度が高すぎる場合であっても、燃焼室３内でのノッキングの発生を回避することができる。更に、燃焼室３内には、過給された吸気が供給されるため、圧縮行程時の筒内圧を上昇させることができ、低圧縮比であっても、圧縮着火燃焼が可能となり、相対的に圧縮着火領域（Ｉ）を高負荷側へ拡大させることができる。

【００４９】このように、本実施の形態によれば、吸気メイン通路１４に機械式過給機１０を介装し、その下流にインタクーラ１１を配設すると共に、このインタクーラ１１をバイパスするＩ/Ｃバイパス通路１４を連通させ、圧縮着火領域（Ｉ）では、基本的に機械式過給機１０で過給昇温された吸気を、Ｉ／Ｃバイパス通路１４を経て燃焼室３へ供給することで、高回転側での体積効率の低下を防止すると共に、圧縮行程時の断熱圧縮において筒内ガス温度を自着火可能な温度まで十分に昇温させることができる。

【００５０】一方、ノッキングが発生したときは、機械式過給機１０から吐出された吸気をインタクーラ１１にて冷却した後、燃焼室３へ供給するようにしたので、残留ガスの熱エネルギが高い高負荷運転時や吸気温度が高い場合であっても、ノッキングの発生を回避することができる。更に、過給された吸気を燃焼室３へ供給するため、低圧縮比であっても、圧縮行程における筒内混合ガスを圧縮着火可能な温度まで昇温させることが可能となる。

【００５１】その結果、エンジンの圧縮比が低い場合であっても、図５のハッチングで示すように、圧縮着火領域（Ｉ）を高回転、高負荷運転側へ限界近くまで拡大させることができる。又、圧縮比を高く設定する必要がないため、火花点火領域（II）においては、ノッキングの発生を抑制しつつ、高出力を得ることができる。

【００５２】尚、本発明は、上述した実施の形態に限るものではなく、例えば、通路切換え手段は、吸気メイン通路８とＩ／Ｃバイパス通路１４の上流側との分岐部に配設して、通路を選択的に切換える弁体であっても良く、分岐部に１つの弁体を配設するだけで良いため、部品点数の削減が図れる。

【００５３】

【発明の効果】以上、説明したように本発明によれば、過給機にて過給された吸気を、異常燃焼が検出されるまでは吸気冷却器を迂回して、燃焼室へ供給するようにしたので、高回転領域での着火の遅延が防止される。又、異常燃焼が検出されたときは吸気冷却器により吸気を冷却した後、燃焼室へ供給するようにしたので、高負荷運転領域での異常燃焼の発生を抑制することができる。更に、過給により筒内圧を上昇させることができるため、低圧縮比化が可能となる。

【００５４】その結果、圧縮着火領域を高回転領域側及び高負荷領域側へ拡大させることが可能となる。

【図面の簡単な説明】

【図１】エンジンの全体構成図

【図２】燃焼制御ルーチンを示すフローチャート

【図３】通路切換え制御ルーチンを示すフローチャート

【図４】（ａ）運転領域が圧縮着火領域にあるときのバルブタイミングを示す説明図、（ｂ）運転領域が火花点火領域にあるときのバルブタイミングを示す説明図

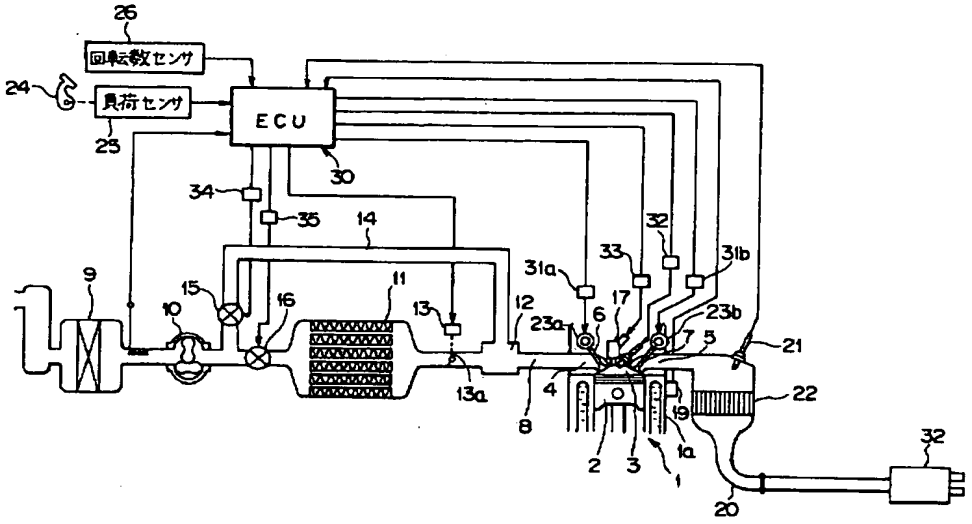
【図５】運転領域判定マップの説明図

【図６】運転領域が圧縮着火領域にあるときのバルブタイミングと筒内圧との関係を示す説明図

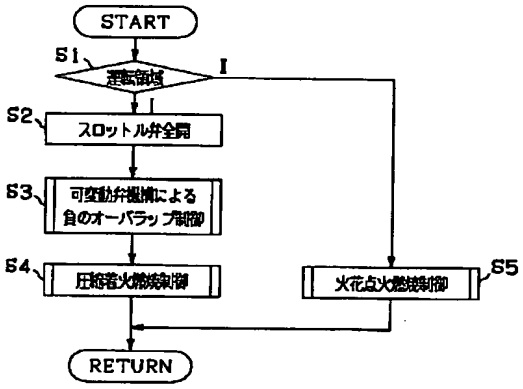
【符号の説明】

１　エンジン
３　燃焼室
６　吸気弁
７　排気弁
８　吸気メイン通路
１０　機械式過給機
１１　インタクーラ（吸気冷却器）
１４　Ｉ／Ｃバイパス通路
１５　バイパス通路開閉弁（通路切換え手段）
１６　メイン通路開閉弁（通路切換え手段）
１７　筒内噴射用インジェクタ
１９　ノックセンサ（異常燃焼検出手段）
２３ａ，２３ｂ　可変動弁機構

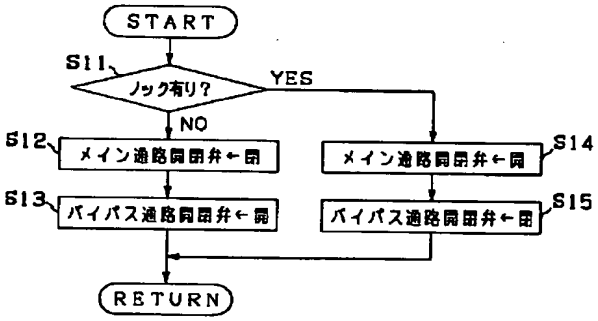
【図１】


回転数センサ
負荷センサ
ECU
26
24
23
30
34
35
14
32
33
31b
31a
9
15
11
16
13
12
23a
6
17
23b
7
5
21
10
13a
4
22
8
19
1a
2
3
1
32
20

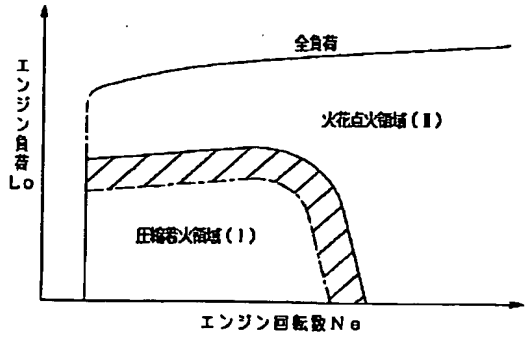
【図２】


START
S1
運転領域
I
S2
スロットル弁全開
S3
可変動弁機構による
負のオーバラップ制御
S4
圧縮着火燃焼制御
S5
火花点火燃焼制御
RETURN

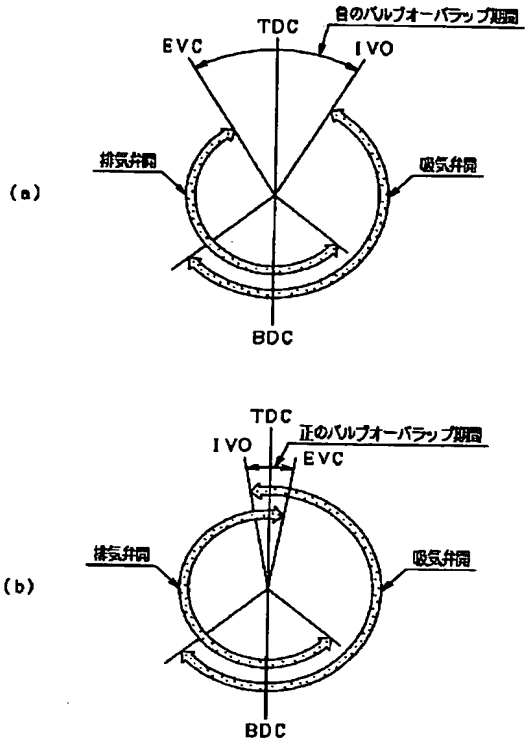
【図３】


START
S11
ノック有り?
YES
NO
S12
メイン通路開閉弁←閉
S14
メイン通路開閉弁←開
S13
バイパス通路開閉弁←開
S15
バイパス通路開閉弁←閉
RETURN

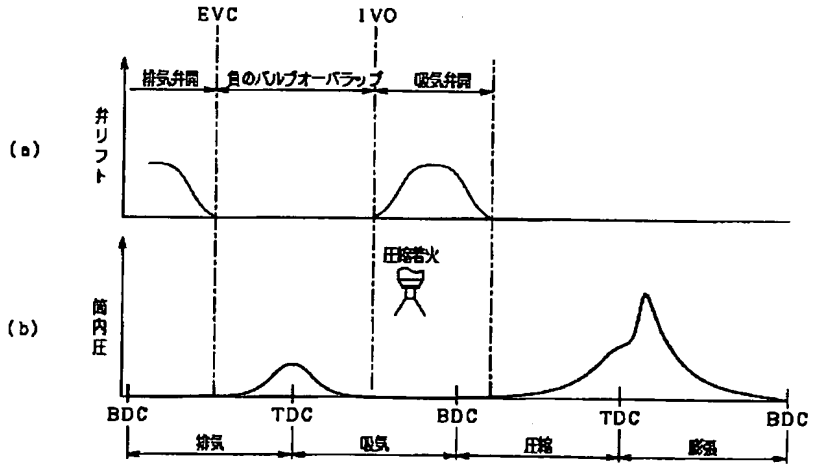
【図５】


全負荷
火花点火領域(Ⅱ)
圧縮着火領域(Ⅰ)
エンジン負荷Lo
エンジン回転数Ne

【図４】



【図６】



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Ｆ０２Ｂ	29/04		Ｆ０２Ｂ	29/04	Ｓ
	33/00			33/00	Ｅ
	37/00	３０２		37/00	３０２Ａ

Ｆ０２Ｄ	13/02	
	23/00	
	41/04	３５１
		３６０
		３６５
	41/22	３５１
	41/38	
	45/00	３６８

		３０２Ｄ
Ｆ０２Ｄ	13/02	Ｇ
	23/00	Ｋ
		Ｎ
	41/04	３５１
		３６０
		３６５
	41/22	３５１
	41/38	Ｚ
	45/00	３６８Ｅ

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AG05
3G084 AA00 BA08 BA23 BA26 CA04
CA09 DA10 DA28 DA38 EB08
EB12 EB22 FA07 FA10 FA25
FA29 FA33
3G092 AA00 AA01 AA11 AA18 AB02
BA02 BB01 DA01 DA02 DA03
DA04 DA07 DA12 DB02 DC00
DC05 DE03S DF01 DF09
DG07 EA04 EA11 EA27 EA28
EA29 EC04 EC10 FA15 FA16
GA06 GA18 HA01Z HA04X
HA06Z HA11Z HA13X HB01X
HC05Z HD03Z HD05Z HE01Z
3G301 HA00 HA01 HA04 HA11 HA19
JA04 JA22 KA09 KA25 LA06
LA07 LB11 LC01 NA07 NC02
ND03 NE12 NE24 PA10Z
PA11Z PA15A PA17Z PC08Z
PD02Z PE01Z PE10A PF03Z

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] In the combustion control system of the compression ignition type engine which the inhalation of air supercharged by the supercharger arranged in the inhalation-of-air Maine path and the fuel injected from an injector are supplied [engine] to a combustion chamber, and carries out compression ignition combustion of the generated mixed gas The inhalation-of-air condensator arranged in the lower stream of a river of the above-mentioned supercharger of the above-mentioned inhalation-of-air Maine path, and the bypass path which opens an end for free passage to the above-mentioned inhalation-of-air Maine path between the above-mentioned supercharger and the above-mentioned inhalation-of-air condensator, and opens the other end for free passage to the above-mentioned inhalation-of-air Maine path of the downstream of the above-mentioned inhalation-of-air condensator, A path change means to connect selectively the above-mentioned bypass path and the above-mentioned inhalation-of-air condensator to the above-mentioned supercharger, When abnormal combustion is detected by an abnormal-combustion detection means to detect the abnormal combustion of the above-mentioned combustion chamber, and the above-mentioned abnormal-combustion detection means, operate the above-mentioned path change means and the above-mentioned above-mentioned supercharger and inhalation-of-air condensator side is opened for free passage. Moreover, it is the combustion control system of the compression ignition type engine characterized by having the path change control means which operates the above-mentioned path change means and makes the above-mentioned supercharger and the above-mentioned bypass path open for free passage when abnormal combustion is not detected by the above-mentioned abnormal-combustion detection means.
[Claim 2] It is the combustion control system of the compression ignition type engine according to claim 1 characterized by having a valve timing setting-out means to set up so that the negative bulb overlap period which closes both the above-mentioned exhaust valve and the above-mentioned inlet valve , applying the valve timing by the above-mentioned good fluctuation valve system before and behind an exhaust air top dead center when a combustion gestalt is compression ignition combustion , the adjustable valve gear which can adjustable set up the valve timing of an inlet valve and an exhaust valve , and may be formed .
[Claim 3] The above-mentioned injector is the combustion control system of claim 1 characterized by being the injector for cylinder injections of fuel which injects a fuel directly into the above-mentioned combustion chamber, or a compression ignition type engine given in two.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the combustion control system of the compression ignition type engine in which it was made to reduce the gas temperature of a combustion chamber, when abnormal combustion occurs.
[0002]
[Description of the Prior Art] Enlarging the ratio of specific beat of working medium by making mixed gas Lean-ize as a means which raises the thermal efficiency of a four stroke cycle engine, and raising a theoretical thermal efficiency is known. Moreover, since an engine is made to inhale more air even when operating with the same torque by Lean-izing mixed gas, pumping loss can be reduced.
[0003] However, Lean-ization of mixed gas has a limitation with protraction of a combustion period, or destabilization of combustion. Then, there is a problem that combustion temperature becomes high and NOx tends to increase by stratification combustion by stratification combustion which brings together in the perimeter of an ignition plug with the condition of having stratification-ized mixed gas, and secures ignitionability by cylinder injection of fuel since rich mixed gas is centralized on the circumference of an ignition plug although he is trying to extend this limitation.
[0004] On the other hand, since a diesel power plant is burned by compression ignition, thermal efficiency is high and Lean-izing with a large air-fuel ratio is possible, but since the air utilization rate at the time of a heavy load is bad, an output is low, and blowdown of soot may be produced and it becomes an exhaust gas cure top problem.
[0005] Then, the compression ignition type engine which carries out multipoint firing of the gasoline mixed gas by adiabatic compression, not using an ignition plug as a means to solve such a problem is proposed. In order to carry out compression ignition combustion of the gasoline mixed gas By it being necessary to activate new mind using hot residual-gas heat, bringing the clausilium stage of an exhaust valve forward as the one approach, and delaying the valve-opening stage of an inlet valve The negative overlap period which both valves close before and behind an exhaust air top dead center is formed, and the technique it was made to confine residual gas in a combustion chamber from the second half of an exhaust stroke to the first half of an intake stroke is known.
[0006] For example, the negative bulb overlap period which closes the both sides of an exhaust valve and an inlet valve before and behind an exhaust air top dead center is prepared in JP,2000-64863,A, and the technique of promoting compression ignition is indicated according to the precompression temperature up of the residual gas confined in the combustion chamber.
[0007]
[Problem(s) to be Solved by the Invention] By the way, although he is trying to aim at improvement in thermal efficiency by controlling the negative bulb overlap period spent before and behind an exhaust air top dead center by the advanced technology mentioned above, the heat energy of residual gas is changed according to an engine load. That is, the residual-gas temperature at the time of low load driving becomes high gradually as it is low and shifts to heavy load operation. Furthermore, delay will arise at the stage when volumetric efficiency falls gradually at and reaches the temperature of the mixed gas in a cylinder which can be lit as it shifts to a high revolution field by the negative bulb overlap period, in order that the valve-opening stage of an inlet valve may be overdue.
[0008] Consequently, an ignition miss will be caused in a heavy load operating range, without whenever [mixture gas temperature] becoming high too much, and becoming easy to generate abnormal combustion, such as knocking, and fully being able to raise whenever [mixture gas temperature] in a quantity revolution field. Therefore, there is inconvenience by which a compression ignition field will be narrowed inevitably.
[0009] This invention prevents delay of firing in a high revolution field, and aims at offering the combustion control system of the compression ignition type engine which can aim at amplification of a compression ignition field while it controls generating of the abnormal combustion in a heavy load operating range in view of the above-mentioned situation.
[0010]
[Means for Solving the Problem] The inhalation of air supercharged by the supercharger which arranged this invention in the inhalation-of-air Maine path in order to attain the above-mentioned object, In the combustion control system of the compression ignition type engine which the fuel injected from an injector is supplied [engine] to a combustion chamber, and carries out compression ignition combustion of the generated mixed gas The inhalation-of-air condensator arranged in the lower stream of a river of the above-mentioned supercharger of the above-mentioned inhalation-of-air Maine path, and the bypass path which opens an end for free passage to the above-mentioned inhalation-of-air Maine path between the above-mentioned supercharger and the above-mentioned inhalation-of-air condensator, and opens the other end for free passage to the above-mentioned inhalation-of-air Maine path of the downstream of the above-mentioned inhalation-of-air condensator, A path change means to connect selectively the above-mentioned bypass path and the above-mentioned inhalation-of-air condensator to the above-mentioned supercharger, When abnormal combustion is detected by an abnormal-combustion detection means to detect the abnormal combustion of the above-mentioned combustion chamber, and the above-mentioned abnormal-combustion detection means, operate the above-mentioned path change means and the above-mentioned above-mentioned supercharger and inhalation-of-air condensator side is opened for free passage. Moreover, when abnormal combustion is not detected by the above-mentioned abnormal-combustion detection means, it is characterized by having the path change control means which operates the above-mentioned path change means and makes the above-mentioned supercharger and the above-mentioned bypass path open for free passage.
[0011] When abnormal combustion is not detected by abnormal-combustion detection means to detect the abnormal combustion of a combustion chamber, a path change control means operates a path change means, and makes a supercharger and a bypass path open for free passage with such a configuration. Then, the inhalation of air supercharged with the supercharger is supplied to a combustion chamber through the bypass path which bypasses an inhalation-of-air condensator. Since supercharge temperature up of the inhalation

of air supplied to a combustion chamber is carried out by the supercharger, the temperature up of the mixed gas in a cylinder is promoted, and decline in the volumetric efficiency by the side of a high revolution is controlled, and the firing delay in a compression ignition stage can be prevented. On the other hand, when abnormal combustion is detected by the abnormal-combustion detection means, a path change control means operates a path change means, and makes a supercharger and an inhalation-of-air condensator open for free passage. Then, the inhalation of air supercharged with the supercharger is supplied to a combustion chamber, after being cooled with an inhalation-of-air condensator. Since the inhalation of air supplied to a combustion chamber is cooled, abnormal combustion is avoidable.

[0012] In this case, the desirable adjustable valve gear which can adjustable set up the valve timing of one inlet valve and an exhaust valve, and when a combustion gestalt is compression ignition combustion, it is characterized by having a valve timing setting-out means to set up so that the negative bulb overlap period which closes both the above-mentioned exhaust valve and the above-mentioned inlet valve, applying the valve timing by the above-mentioned good fluctuation valve system before and behind an exhaust air top dead center may be formed.

[0013] 2) It is characterized by the above-mentioned injector being an injector for cylinder injections of fuel which injects a fuel directly into the above-mentioned combustion chamber.

[0014]

[Embodiment of the Invention] Hereafter, the gestalt of 1 operation of this invention is explained based on a drawing. The whole engine block diagram is shown in drawing 1 .

[0015] the sign 1 of this drawing -- an inlet valve and 7 are exhaust valves, the inhalation-of-air Maine path 8 is opened for free passage by the inlet port 4, and, as for an engine and 2, the air cleaner 9 is arranged [an inlet port and 5 / an exhaust port and 6] in the upper edge of this inhalation-of-air Maine path 8 for a combustion chamber and 4, as for a piston and 3. Moreover, the mechanical-cable-type supercharger 10 driven with an engine is arranged, the intercooler 11 as an inhalation-of-air condensator is infixed at the lower stream of a river of this mechanical-cable-type supercharger 10, it is this intercooler 11, and also the air chamber 12 is formed down-stream on the lower stream of a river of the air cleaner 9 of the inhalation-of-air Maine path 8. Moreover, throttle-valve 13a is arranged between the intercooler 11 of the inhalation-of-air Maine path 8, and the air chamber 12. These throttle-valve 13a is formed successively by the electronics control throttle equipment 13 which controls a throttle opening electronically.

[0016] Moreover, between the mechanical-cable-type supercharger 10 of the inhalation-of-air Maine path 8, and the intercooler 11, the upper edge of the I/C bypass path 14 is opened for free passage, and, on the other hand, the down-stream edge of the I/C bypass path 14 is opened for free passage by the air chamber 12. In addition, opening of the down-stream edge of the I/C bypass path 14 may be carried out between the intercooler 11 of the inhalation-of-air Maine path 8, and throttle-valve 13a.

[0017] Furthermore, the bypass path closing motion valve 15 is infixed in the upstream of the I/C bypass path 14, and the Maine path closing motion valve 16 is infixed between the upstream of the intercooler 11 of the inhalation-of-air Maine path 8, and the upper edge of the I/C bypass path 14. In addition, the path change means consists of these double door clausiliums 15 and 16.

[0018] Furthermore, the nozzle hole of the injector 17 for cylinder injections of fuel and the ignition section of an ignition plug 18 are ****(ed) by the top face of a combustion chamber 3. Moreover, the knock sensor 19 which is an example of an abnormal-combustion detection means which detects the existence of knocking generating which is abnormal combustion is arranged in cylinder block 1a. Moreover, the air-fuel ratio sensors 21, such as O2 sensor or a broader-based air-fuel ratio sensor, are ****(ed) by the flueway 20 which is open for free passage to an exhaust port 5, and the three way component catalyst 22 which purifies by performing CO in exhaust gas, and oxidation of HC and reduction of NOx on the lower stream of a river of this air-fuel ratio sensor 21 is infixed.

[0019] In addition, the engine adopted with the gestalt of this operation controlling abnormal combustion, such as knocking, the compression ratio is set as the low value (12 to about [for example,] 14) which can be operated in a practical use field so that heavy load operation by the usual jump spark ignition can be realized.

[0020] Moreover, an inlet valve 6 and exhaust valves 7 are respectively formed successively by the adjustable valve gears 23a and 23b. the two-step type cam mechanism to which each of these adjustable valve gears 23a and 23b switch two kinds of cam crests where profiles differ, and well-known electromagnetism -- it consists of continuation good fluctuation valve systems using a valve train etc., and transfer operation is carried out according to a operating range based on the control signal from the electronic control unit (ECU) 30 mentioned later.

[0021] By the way, in ECU30, a operating range is judged with reference to the operating-range judging map shown in drawing 5 based on an engine load Lo and an engine speed Ne. A operating range is a load in low, and is classified into the jump-spark-ignition field (II) of the compression ignition field (I) of a low middle turn field, and a heavy load field or a high revolution field, in a compression ignition field (I), performs overly RIN compression ignition combustion of an air-fuel ratio, and performs the usual jump-spark-ignition combustion in a jump-spark-ignition field (II). Since compression ignition combustion is below NOx generation temperature and can be burned, NOx hardly occurs, but since the excess air factor is high, moreover, a three way component catalyst 29 is operated as an oxidation catalyst which purifies CO and HC in exhaust gas by oxidation reaction.

[0022] And a operating range is in a compression ignition field (I), and when a combustion gestalt is set as compression ignition combustion, as shown in drawing 4 R> 4 (a), it is switched so that the negative bulb overlap period which both an exhaust valve 7 and the inlet valve 6 close [valve timing] before and behind an exhaust air top dead center (TDC) may be formed. Moreover, a operating range is in a jump-spark-ignition field (II), and when a combustion gestalt is set as the usual jump-spark-ignition combustion, as shown in this drawing (b), it is switched so that the forward bulb overlap period which both an exhaust valve 7 and the inlet valve 6 open [valve timing] before and behind an exhaust air top dead center (TDC) may be formed.

[0023] The information detected by each sensor mentioned above is inputted into an electronic control unit (ECU) 30. The load sensor 25 which detects an engine load Lo from the amount of treading in of an accelerator pedal 24 in addition to each sensor by which this ECU30 is constituted as a core, and mentioned the microcomputer above to the input side of this ECU30, engine-speed sensor which detects engine speed Ne 26 grade, and the various sensor switches which detect engine operational status are connected.

[0024] Moreover, each adjustable valve gears 23a and 23b are connected according to an individual through inlet-valve actuation circuit 31a and exhaust valve actuation circuit 31b, an ignition plug 18 is connected to the output side of ECU30 through the ignition actuation circuit 32, and the injector 17 for cylinder injections of fuel is connected to it through the injector actuation circuit 33. Furthermore, while electronics control throttle equipment 13 is connected, the bypass path closing motion valve 15 and the Maine path closing motion valve 16 are respectively connected to the output side of ECU30 through the actuation circuits 34 and 35.

[0025] In addition, although not illustrated, the bypass path which bypasses the mechanical-cable-type supercharger 10 is established in the inhalation-of-air Maine path 8, and the charge pressure control valve which controls charge pressure to this bypass path is infixed. It opens at the time of for example, a high revolution and heavy load operation, and this charge pressure control valve reduces the charge pressure at the time of a high revolution and heavy load operation, and avoids abnormal combustion, such as knocking in a jump-spark-ignition field (II).

[0026] Based on the engine speed Ne which detected ECU30 by the engine-speed sensor 26, and the engine load Lo detected by the load sensor 33, it investigates whether a operating range is in a compression ignition field (I), or it is in a jump-spark-ignition field (II). and it was judged that it was in a compression ignition field (I) -- coming -- while carrying out full admission actuation of the throttle-valve 13a, the valve timing of an exhaust valve 7 and an inlet valve 6 is controlled before and behind an exhaust air top dead center (TDC) so that the negative bulb overlap period which both an exhaust valve 7 and the inlet valve 6 close is formed.
[0027] Then, residual gas is shut up in a combustion chamber 3 during a negative bulb overlap period, precompression temperature up of the inhalation of air supplied to a combustion chamber 3 in the condition of having been pressurized by this residual gas and the mechanical-cable-type supercharger 10 is carried out by the adiabatic compression at the time of a compression stroke, and compression ignition combustion is made to perform. Consequently, even if it sets up low so that a compression ratio can be operated in a practical use field, it becomes possible to carry out temperature up of the gas in a cylinder to the temperature in which compression ignition is possible.
[0028] Moreover, when it judges that a operating range is in a jump-spark-ignition field (II), while considering as the actuation which interlocked throttle-valve 13a with the accelerator pedal 24, the valve timing of an exhaust valve 7 and an inlet valve 6 is switched so that the forward bulb overlap period which both an exhaust valve 7 and the inlet valve 6 open may be formed before and behind an exhaust air top dead center (TDC). Furthermore, the charge pressure control valve (not shown) infixed in the bypass path which bypasses the mechanical-cable-type supercharger 10 is controlled, and the usual jump-spark-ignition combustion control is performed by adjusting charge pressure, avoiding abnormal combustion, such as knocking.
[0029] When a operating range is in a compression ignition field (I), the bypass path closing motion valve 15 is opened, and clausilium of the Maine path closing motion valve 16 is carried out. Therefore, the inhalation of air pressurized by the mechanical-cable-type supercharger 10 passes along the I/C bypass path 14, and is supplied to a combustion chamber 3 through an air chamber 12. And when the monitor of the output signal of a knock sensor 19 is carried out and abnormal combustion, such as knocking, is detected, while closing the bypass path closing motion valve 15 promptly, the Maine path closing motion valve 16 is opened. Then, since it is cooled by the intercooler 11 and the inhalation of air by which the mechanical-cable-type supercharger 10 was connected to the intercooler 11, and supercharge temperature up was carried out with the mechanical-cable-type supercharger 10 is supplied to a combustion chamber 3, abnormal combustion, such as knocking, is avoided.
[0030] On the other hand, when a operating range is in a jump-spark-ignition field (II), clausilium of the bypass path closing motion valve 15 is carried out, the Maine path closing motion valve 16 is opened, and since it is cooled by the intercooler 11 and the supercharged inhalation of air is supplied to a combustion chamber 3, a charging efficiency becomes high.
[0031] By the way, as mentioned above, in order to form a negative bulb overlap period in a compression ignition field (I), at the time of the usual jump-spark-ignition control, the valve-opening stage of an inlet valve 6 compares, and the angle of delay is carried out. Therefore, it becomes easy for volumetric efficiency to fall as it shifts to a high revolution side, but since the intake-air temperature is rising in case decline in volumetric efficiency is controlled and the mechanical-cable-type supercharger 10 is moreover passed, since the supercharged inhalation of air is supplied, the temperature up of the mixed gas by the adiabatic compression at the time of a compression stroke is promoted, and good compression ignition combustion can be obtained. Moreover, since the inhalation of air which supercharged is supplied to a combustion chamber 3, even if it sets up a compression ratio low, it becomes possible to heighten cylinder internal pressure.
[0032] In this case, it becomes possible to make a compression ignition field (I) expand to drawing 5 to near the limitation to a heavy load side and high revolution side, as hatching shows, since generating of knocking was controlled as the combustion chamber 3 after cooling the air supercharged when the time of heavy load operation and an intake-air temperature were too high and abnormal combustion, such as knocking, occurred by the intercooler 11 was supplied.
[0033] In addition to the usual combustion-control functions, such as a fuel-injection control function and an ignition-timing control function, ECU30 is equipped with the valve timing setting up function and the path change control function which performs change control of each path closing motion valves 15 and 16. A combustion-control function and a valve timing setting up function are specifically performed according to the combustion-control routine shown in drawing 2 , and a path change control function is performed according to the path change control routine shown in drawing 3 .
[0034] In the combustion-control routine shown in drawing 2 , a operating range is first investigated at step S1 with reference to the operating-range map shown in drawing 5 based on an engine speed Ne and an engine load Lo.
[0035] And when a operating range is in a compression ignition field (I), after it progresses to step S2 and carries out full admission actuation of the throttle-valve 13a, it progresses to step S3 and the driving signal used as the valve timing which forms a negative bulb overlap period (refer to drawing 4 (a) and drawing 6 (a)) is outputted to the adjustable valve gears 23a and 23b. That is, when the adjustable valve gears 23a and 23b are two-step type cam mechanisms, the signal which chooses the cam crest which forms negative bulb overlap is outputted, and, in the case of a continuation good fluctuation valve system, a bulb keying signal is outputted to the timing which forms negative bulb overlap.
[0036] Then, the tooth lead angle of the clausilium stage EVC of an exhaust valve 7 is carried out to a front [top dead center / (TDC) / exhaust air] side, and the angle of delay of the valve-opening stage IVO of an inlet valve 6 is carried out to the backside [top dead center / (TDC) / exhaust air], and residual gas is shut up in a combustion chamber 3 in the negative bulb overlap period which both these valves 6 and 7 of both close (refer to drawing 6 (b)). And if a piston 2 passes through an exhaust air top dead center (TDC), and shifts to an intake stroke and an inlet valve 6 is opened in the valve-opening stage IVO, the inhalation of air supercharged by the mechanical-cable-type supercharger 10 will be led to a combustion chamber 3. If this inhalation of air is supplied to a combustion chamber, while heating temperature up of it will be carried out by the heat energy of residual gas, temperature up of it is carried out by the adiabatic compression at the time of a compression stroke.
[0037] Subsequently, it progresses to step S4, a compression ignition combustion control is performed, and it escapes from a routine. When the fuel injection timing in which compression ignition combustion is possible, and fuel oil consumption are set up and it reaches at predetermined fuel injection timing, it is made to inject from the injector 17 for cylinder injections of fuel in a compression ignition combustion control (refer to drawing 6 (b)). In addition, a compression ignition field (I) is subdivided to a stratification compression ignition field and a homogeneity compression ignition field in this case, and it may be made to carry out adjustable setting out of the fuel injection timing for every field.
[0038] Moreover, if it is judged with a operating range being in a jump-spark-ignition field (II) and progresses to step S5 at step S1, the combustion control by the usual jump spark ignition will be performed, and it will escape from a routine. If it shifts to a jump-spark-ignition combustion control, the driving signal used as the valve timing which forms a forward bulb overlap period (refer to drawing 4 R> 4 (b)) will be outputted to the adjustable valve gears 23a and 23b. That is, when the adjustable valve gears 23a and 23b are two-step type cam mechanisms, the signal which chooses the cam crest which forms forward bulb overlap is outputted, and, in the case of a continuation good fluctuation valve system, a bulb keying signal is outputted to the timing which forms forward bulb

overlap.
[0039] Consequently, it operates in the forward bulb overlap period (refer to drawing 4 (b)) which an inlet valve 6 and an exhaust valve 7 open from [both] the valve timing at the time of the usual jump spark ignition, i.e., the telophase of an exhaust stroke, to the early stages of an intake stroke.
[0040] Simultaneously, it considers as the actuation which interlocked throttle-valve 13a with the accelerator pedal 24. Furthermore, while carrying out valve-opening actuation of the Maine path closing motion valve 16 through the Maine path closing motion valve actuation circuit 35, close actuation of the bypass path closing motion valve 15 is carried out through the bypass path closing motion valve actuation circuit 34. Consequently, after the inhalation of air which passed through the bypass path (not shown) which is supercharged by the mechanical-cable-type supercharger 10, or bypasses this mechanical-cable-type supercharger 10 passes along the inhalation-of-air Maine path 8 and is cooled by the intercooler 11, a combustion chamber 3 is supplied.
[0041] Furthermore, fuel oil consumption, fuel injection timing, ignition timing, etc. are returned to the usual jump-spark-ignition control. In addition, since the fuel-injection control and ignition-timing control at the time of jump-spark-ignition control are well-known, explanation here is omitted.
[0042] Moreover, if judged with a operating range being in a compression ignition field (I), the path change control routine shown in drawing 3 will be started.
[0043] By this routine, step S11 investigates the existence of knocking generating from the output signal of a knock sensor 19 first. When knocking has not occurred, it progresses to step S12 and the signal which closes the Maine path closing motion valve 16 to the Maine path closing motion valve actuation circuit 35 is outputted. Subsequently At step S13, the signal which makes the pie pass path closing motion valve 15 open to the bypass path closing motion valve actuation circuit 34 is outputted, and it escapes from a routine.
[0044] Then, the inhalation-of-air Maine path 8 which is open for free passage to an intercooler 11 is intercepted, and the I/C bypass path 14 is opened for traffic, and the inhalation of air supercharged by the mechanical-cable-type supercharger 10 is supplied to a combustion chamber 3, without passing along the I/C bypass path 14 and being cooled by the intercooler 11.
[0045] Since a combustion chamber 3 is supplied without controlling decline in the volumetric efficiency by the side of a high revolution, and moreover cooling this inhalation of air by the intercooler 11, since the supercharged inhalation of air is supplied to a combustion chamber 3 where temperature up is carried out, Even if it is a high revolution side, temperature up of the mixed gas in a combustion chamber 3 can fully be carried out to the temperature in which autohesion fire is possible, and a compression ignition field (I) can be made to expand to a high revolution side relatively.
[0046] On the other hand, at step S11, when generating of knocking is detected, it branches to step S4, and the signal which opens the Maine path closing motion valve 16 to the Maine path closing motion valve actuation circuit 35 is outputted, subsequently the signal to which clausilium of the pie pass path closing motion valve 15 is carried out to the bypass path closing motion valve actuation circuit 34 at step S15 is outputted, and it escapes from a routine.
[0047] Then, the inhalation-of-air Maine path 8 which is open for free passage to an intercooler 11 is opened for traffic, and the I/C bypass path 14 is intercepted, and the inhalation of air supercharged by the mechanical-cable-type supercharger 10 is supplied to a combustion chamber 3, after passing along the inhalation-of-air Maine path 8 and being cooled by the intercooler 11.
[0048] When knocking occurs, in order to cool the inhalation of air supplied to a combustion chamber 3 by the intercooler 11, even if it is the time of heavy load operation with the high heat energy of residual gas, and the case where the temperature of the inhalation of air breathed out from the mechanical-cable-type supercharger 10 is too high, generating of knocking in a combustion chamber 3 is avoidable. Furthermore, the cylinder internal pressure at the time of a compression stroke can be raised, even if it is a low compression ratio, compression ignition combustion can be attained and a compression ignition field (I) can be made to expand to a heavy load side relatively, since the supercharged inhalation of air is supplied in a combustion chamber 3.
[0049] Thus, while according to the gestalt of this operation infixing the mechanical-cable-type supercharger 10 in the inhalation-of-air Maine path 14 and arranging an intercooler 11 in the lower stream of a river The I/C bypass path 14 which bypasses this intercooler 11 is made to open for free passage. In a compression ignition field (I) By supplying fundamentally the inhalation of air by which supercharge temperature up was carried out to a combustion chamber 3 through the I/C bypass path 14 with the mechanical-cable-type supercharger 10, while preventing decline in the volumetric efficiency by the side of a high revolution, in the adiabatic compression at the time of a compression stroke, temperature up of the gas temperature in a cylinder can fully be carried out to the temperature in which autohesion fire is possible.
[0050] On the other hand, since it was made to supply a combustion chamber 3 when knocking occurs after cooling the inhalation of air breathed out from the mechanical-cable-type supercharger 10 by the intercooler 11, generating of knocking is avoidable even if it is the time of heavy load operation with the high heat energy of residual gas, and the case that an intake-air temperature is high. Furthermore, in order to supply the supercharged inhalation of air to a combustion chamber 3, even if it is a low compression ratio, it becomes possible to carry out temperature up of the mixed gas in a cylinder in a compression stroke to the temperature in which compression ignition is possible.
[0051] Consequently, even if it is the case that an engine compression ratio is low, a compression ignition field (I) can be made to expand to near the limitation to a high revolution and heavy load operation side, as hatching of drawing 5 shows. Moreover, since it is not necessary to set up a compression ratio highly, high power can be obtained in a jump-spark-ignition field (II), controlling generating of knocking.
[0052] In addition, you may be the valve element which does not restrict this invention to the gestalt of operation mentioned above, and arranges a path change means in a tee with the upstream of the inhalation-of-air Maine path 8 and the I/C bypass path 14, for example, switches a path selectively, and since what is necessary is just to arrange one valve element in a tee, the cutback of components mark can be aimed at.
[0053]
[Effect of the Invention] As mentioned above, since an inhalation-of-air condensator is bypassed until abnormal combustion is detected in the inhalation of air supercharged with the supercharger according to this invention as explained, and it was made to supply a combustion chamber, delay of firing in a high revolution field is prevented. Moreover, since it was made to supply a combustion chamber after cooling inhalation of air with an inhalation-of-air condensator, when abnormal combustion is detected, generating of the abnormal combustion in a heavy load operating range can be controlled. Furthermore, since cylinder internal pressure can be raised by supercharge, low compression ratio-ization is attained.
[0054] Consequently, it becomes possible to make a compression ignition field expand to a high revolution field and heavy load field side.

[Translation done.]

* NOTICES *

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3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The whole engine block diagram
[Drawing 2] The flow chart which shows a combustion-control routine
[Drawing 3] The flow chart which shows a path change control routine
[Drawing 4] (a) The explanatory view showing valve timing in case the explanatory view and (b) operating range which show valve timing in case a operating range is in a compression ignition field are in a jump-spark-ignition field
[Drawing 5] The explanatory view of a operating-range judging map
[Drawing 6] The explanatory view showing the relation between valve timing in case a operating range is in a compression ignition field, and cylinder internal pressure
[Description of Notations]
1 Engine
3 Combustion Chamber
6 Inlet Valve
7 Exhaust Valve
8 Inhalation-of-Air Maine Path
10 Mechanical-Cable-Type Supercharger
11 Intercooler (Inhalation-of-Air Condensator)
14 I/C Bypass Path
15 Bypass Path Closing Motion Valve (Path Change Means)
16 Maine Path Closing Motion Valve (Path Change Means)
17 Injector for Cylinder Injections of Fuel
19 Knock Sensor (Abnormal-Combustion Detection Means)
23a, 23b Adjustable valve gear

[Translation done.]

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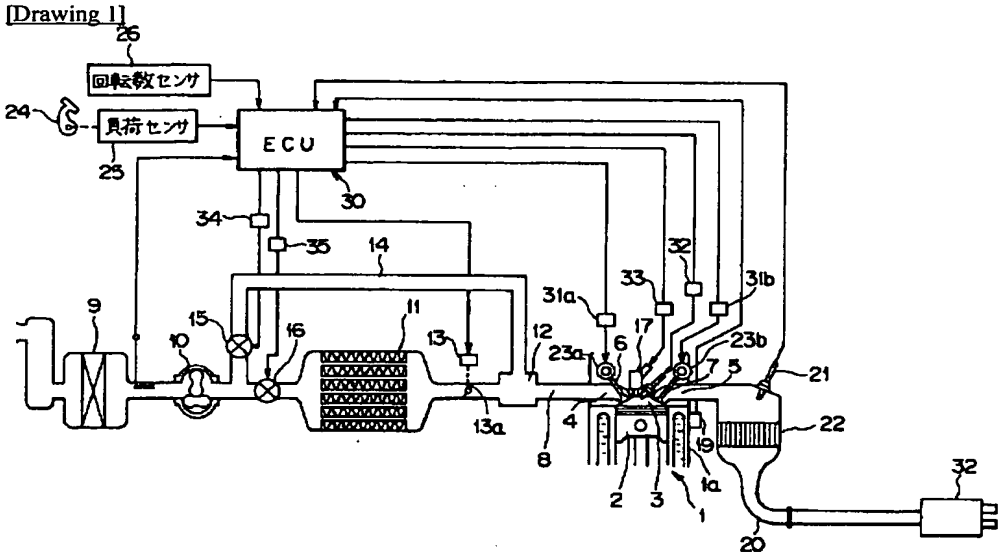
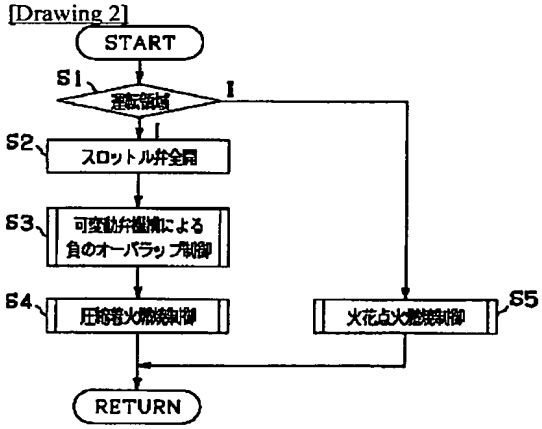
DRAWINGS

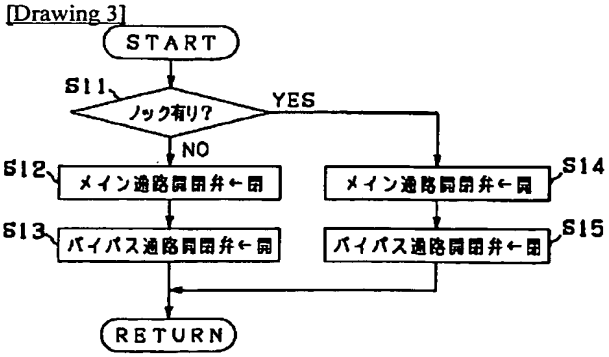
[Drawing 1]



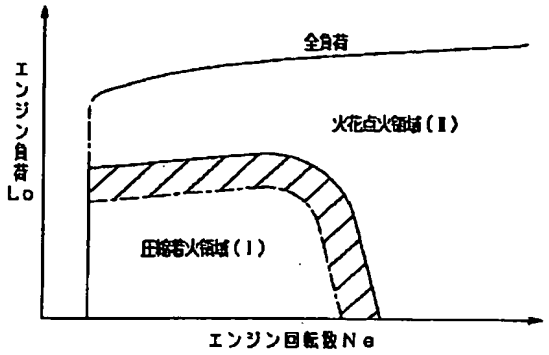
[Drawing 2]



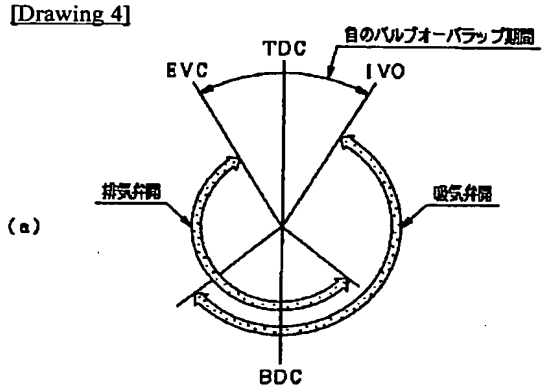
[Drawing 3]



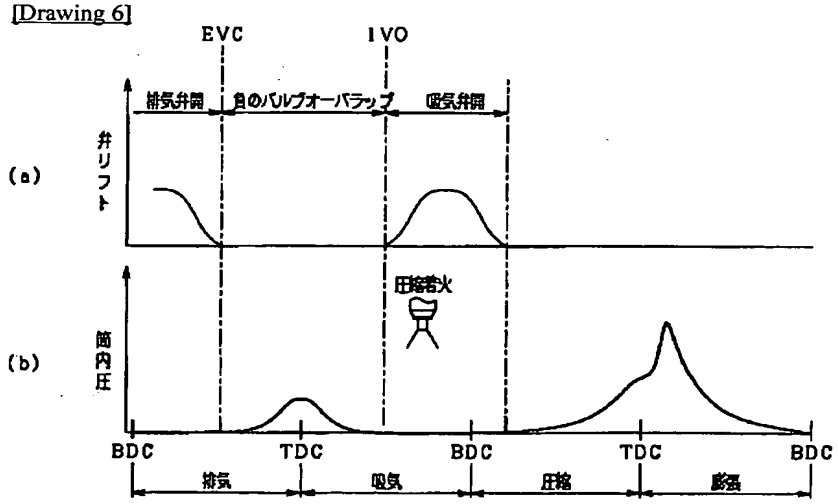
[Drawing 5]



[Drawing 4]



[Drawing 6]



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